Commercial Application of Regenesys™ Flow Battery Technology

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Public Power Institute

- Educate and promote the role of public power in the Utility market place.
- Promote and develop new technologies that sustain the environment and provide competitive priced reliable sources of electrical generation and transmission.

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PPI Bridges the Gap

Research and Development

Demonstration

Deployment

Universities, labs, etc.

PPI

Private enterprise

RD^3 = Research Development, Demonstration & Deployment

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Why TVA's Interest in Energy Storage?

- Alternative to natural gas fired CTs.
- Alternative for frequency regulation.
- Need to level the loads on TVA generation.
- Meet growing customer needs for improved power quality and reliability.
- Need to more effectively utilize renewable energy sources

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Technologies Considered

- Regenesys
- Vanadium Redox Battery (VRB)
- Powercell Zinc Flow Battery
- ZBB Zinc Bromide Battery

Common Attributes

- Electrolytes stored at any charge for long periods.
- Power capability independent of storage capacity
- Electrolyte separation required
- Use of bipolar stacks
- Maximized electrode surface Area

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Why choose the Regenesys technology?

- Potential for 10 - 100MW power capability
- Multiple system benefits
- Large storage capacity
- Inexpensive electrolyte materials
- Well developed production system

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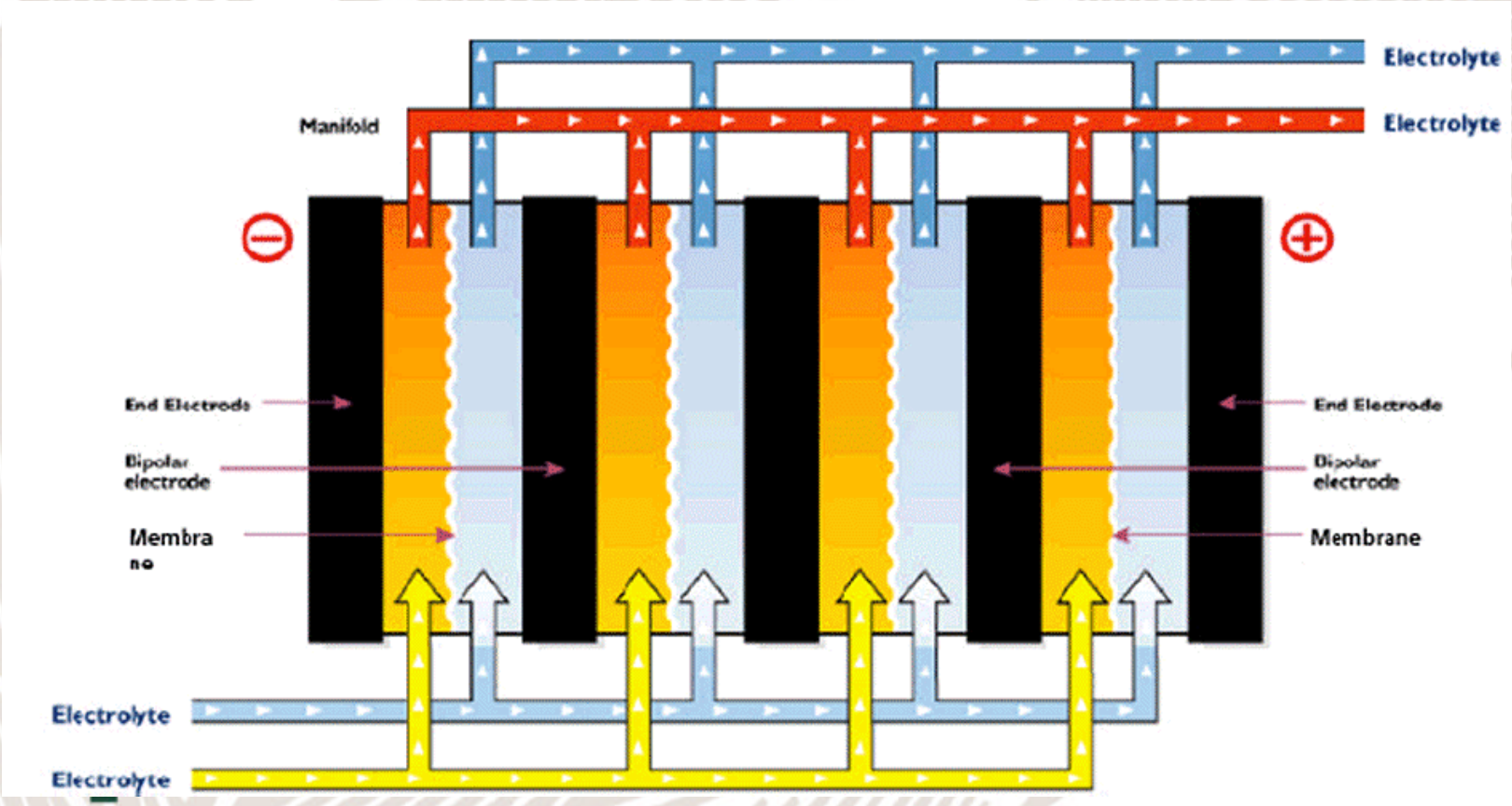
Regenesys™ Bipolar Cells



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Regenesys™ XL Module

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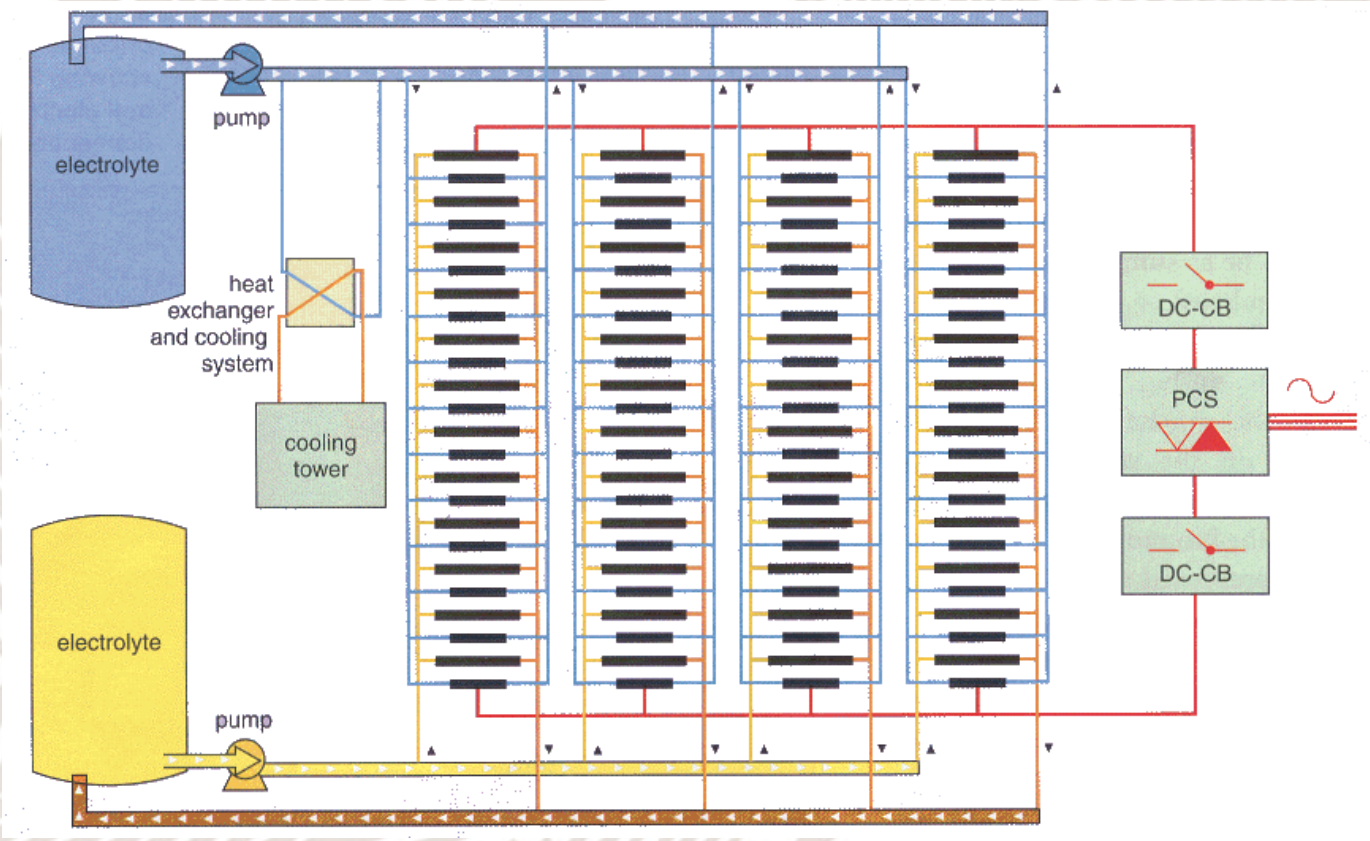
Regenesys™ Module Array



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Benefits to TVA system

- Provide a less volatile electricity market place.
- Provide premium uninterruptible power to customers.
- Improve transmission line dynamic and voltage stability.
- Manage the flow of power across transmission infrastructure and remove congestion.
- Provide power systems the ability to regulate power system frequency.
- Improve the value of non-dispatchable renewable resources like wind and solar.

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TVA System Advantages

- Delay or eliminate need to upgrade substations or lines (increased voltage, reconductor, etc..).
- Delay or eliminate need for new lines or substations
- Sell or provide arbitrage services?
- Sell or provide frequency regulation service?

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Primary functions of the planned Regenesys Reference Plant

- 12 MW, 120MWh nominal plant
- UPS at 6 MW for 3- 4 hours
- Arbitrage capability
- Voltage and frequency support

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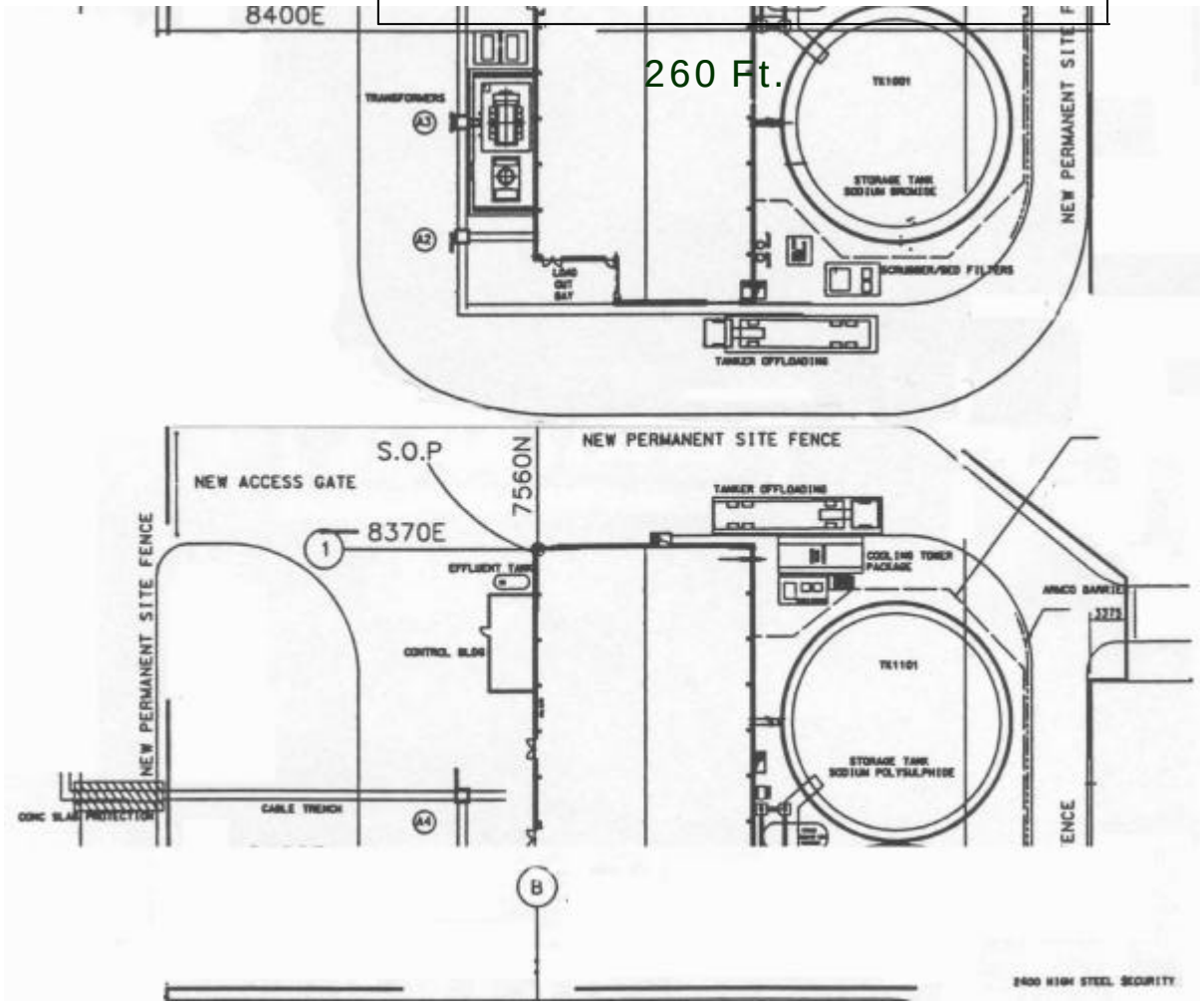
Footprint of the Little Barford Regenesys™ Energy Storage Plant, UK



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Current status at Little Barford March 2001

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Discharge Control/Mitigation

- Fugitive gases
  - redundant carbon filters and monitoring stations
- Cooling water discharge
  - local treatment plant
- Non hazardous solid wastes
  - Sold locally or removed by truck to appropriate facility

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Plant Siting

- “Locations” near substations
- Reliability improvement
- Avoided transmission construction costs
- Need for premium power
- Evaluated sites near preferred locations

Licensing & Permits

- Environmental Assessment
- FONSI
- Clean Air Act - Pre-construction permit
- Water - Pretreatment permit?

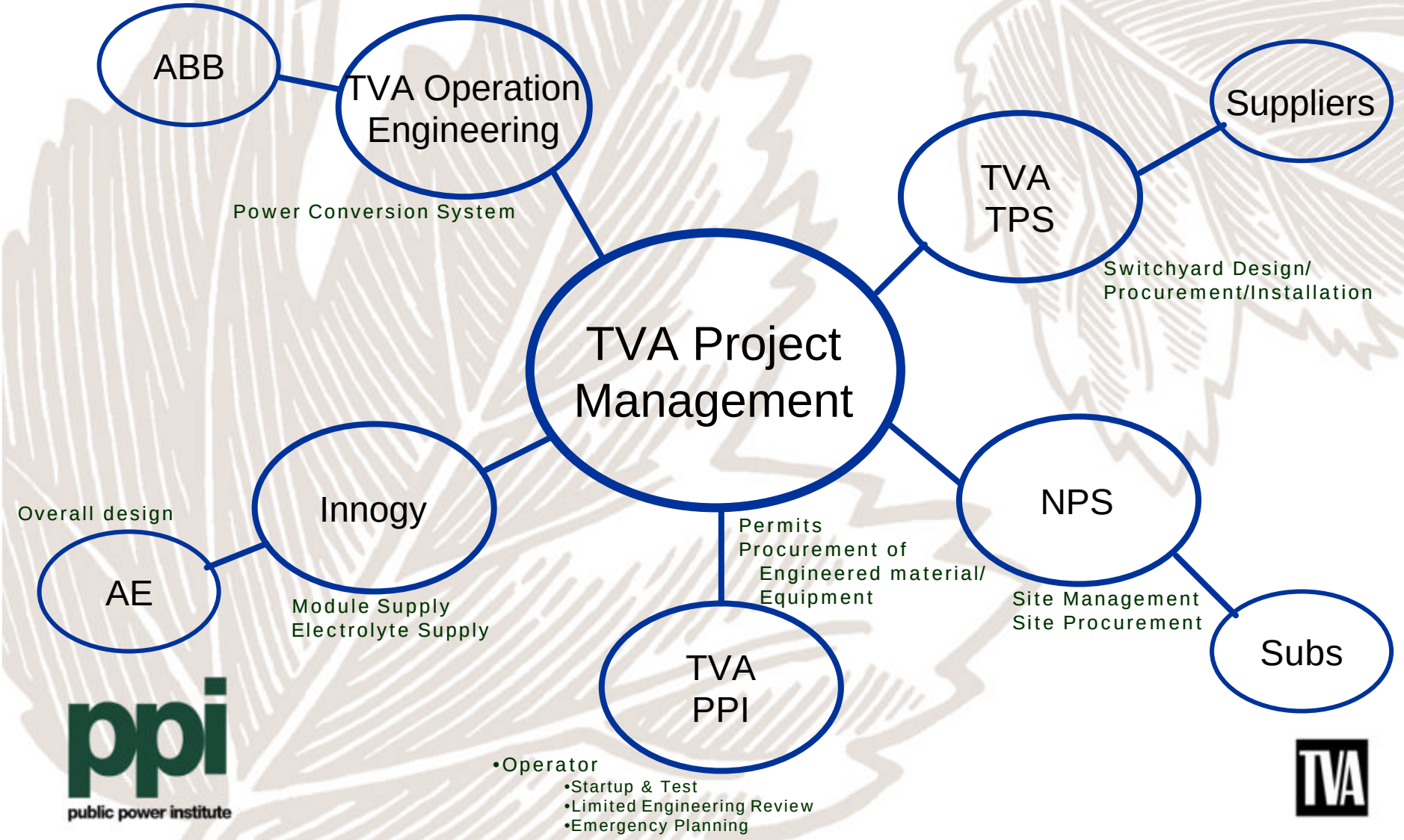
Emergency Plan - EPA

- Reference - 40 CFR - 68
- Plan must be generated under general duty clause
- Plan submittal is not required

Hazop - OSHA

- Reference - 29 CFR 1910.119
  - Process Safety Management of Highly Hazardous Chemicals
- Plan must be generated under general duty clause

Regenesys Project Interfaces



Regenesys Schedule Milestones

	2001	2002	2003
• Environmental Assessment Complete	Early May		
• Public Review	Late June		
• Permits Complete	Late June		
• Initial Design Review Complete	Late June		
• Foundation Design Package Issued	Late June		
• TVA Plant Design Complete	November		
• PCS Design Complete	July		
• PCS Installed		February	
• Substation Design Complete		February	
• Plant Construction Complete		July	
• Substation Upgrade Complete		July	
• PCS Testing Complete		October	
• Plant Testing Complete - Plant Hand-over			January

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